

VALIDATION OF LOW-SPATIAL-RESOLUTION AUTOMATED VICARIOUS CALIBRATION RESULTS

USING HIGH-SPATIAL-RESOLUTION DATA

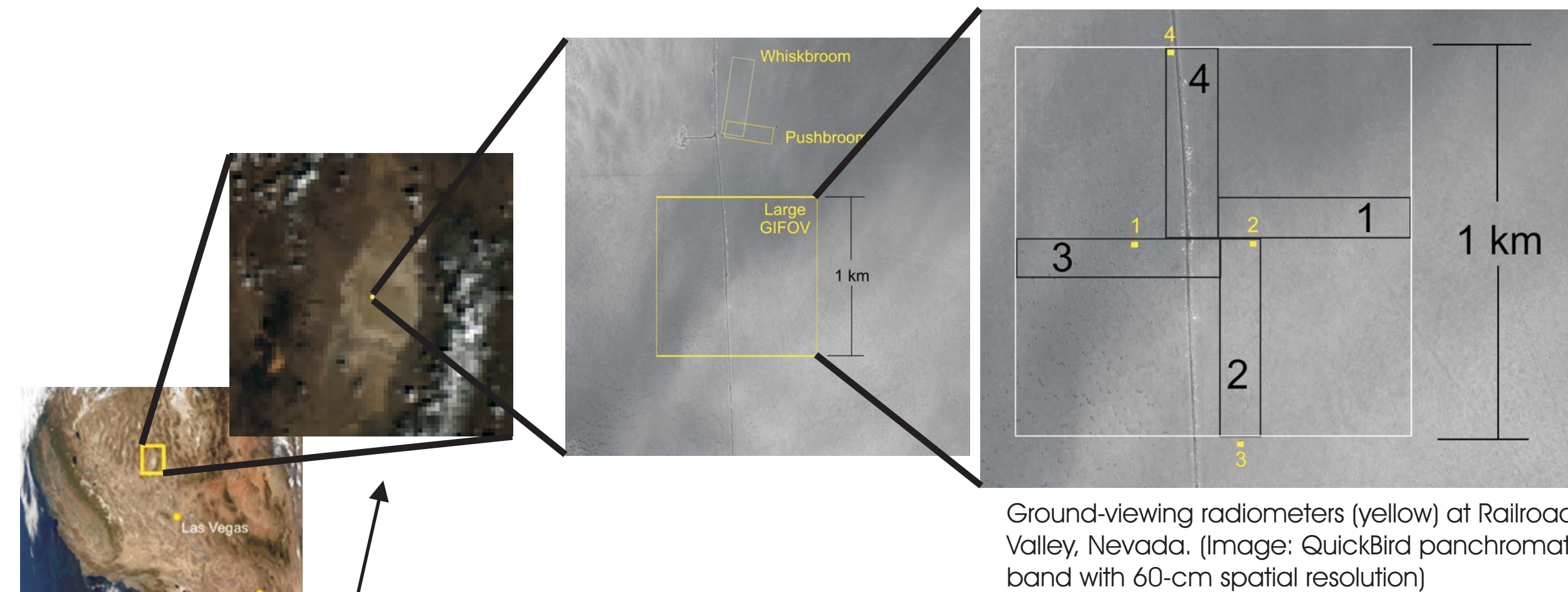
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AUTOMATED APPROACH TO GROUND-BASED VICARIOUS CALIBRATION

- The Remote Sensing Group developed the *Radiometric Calibration Test Site (RadCaTS)* concept and instrumentation suite. It has been in use at Railroad Valley Playa, Nevada, since 2004.
- RadCaTS is based on the reflectance-based approach to determine top-of-atmosphere radiance
- The ground-based instrumentation consists of 4 nadir-viewing multispectral radiometers, a meteorological station, and a Cimel Sun photometer
- RadCaTS is used for such large-footprint sensors as MODIS, AVHRR, and GOES, but is scalable to sensors with smaller GIFOVs

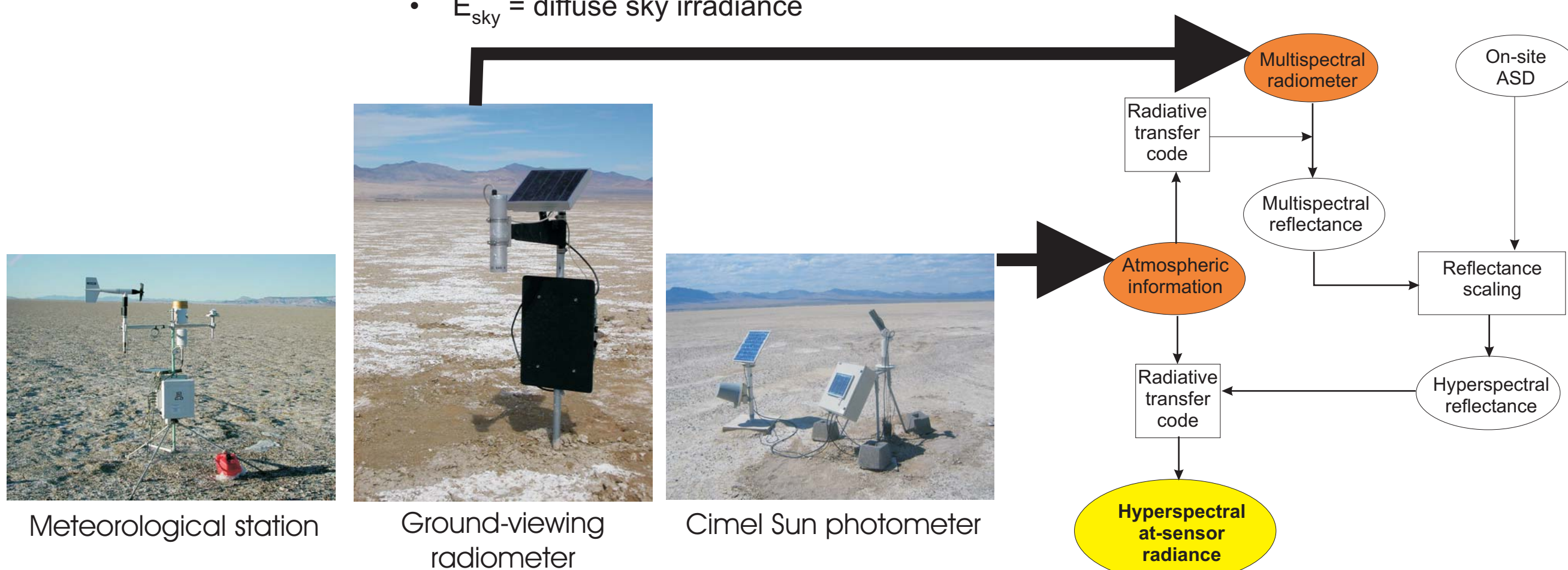


Ground-viewing radiometers (yellow) at Railroad Valley, Nevada. (Image: QuickBird panchromatic band with 60-cm spatial resolution)

$$\rho = \frac{\pi C_{LED} V_{LED}}{E_0 \tau_{solar} \cos \theta + E_{sky}}$$

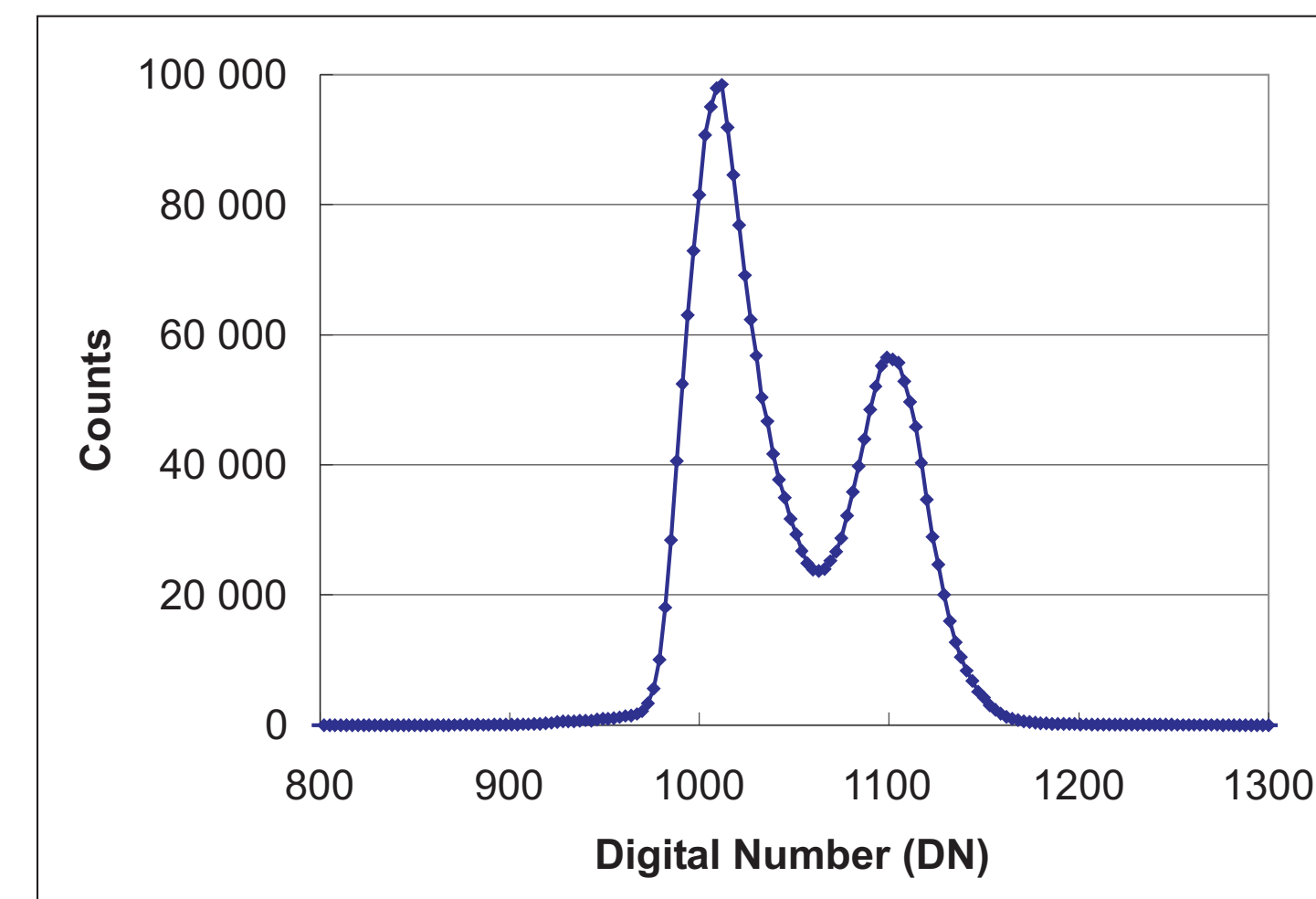
MODIS image

- ρ = surface BRF
- C_{LED} = calibration coefficient
- V_{LED} = LED radiometer output voltage
- E_0 = exoatmospheric solar irradiance
- τ_{solar} = direct solar beam transmission
- θ = solar zenith angle
- E_{sky} = diffuse sky irradiance



Spatial Uniformity of 1-km² Site

- Average QuickBird value was 1059.5 DN
- Approximately 50% of radiometric dynamic range
- These results are used as baseline for other results



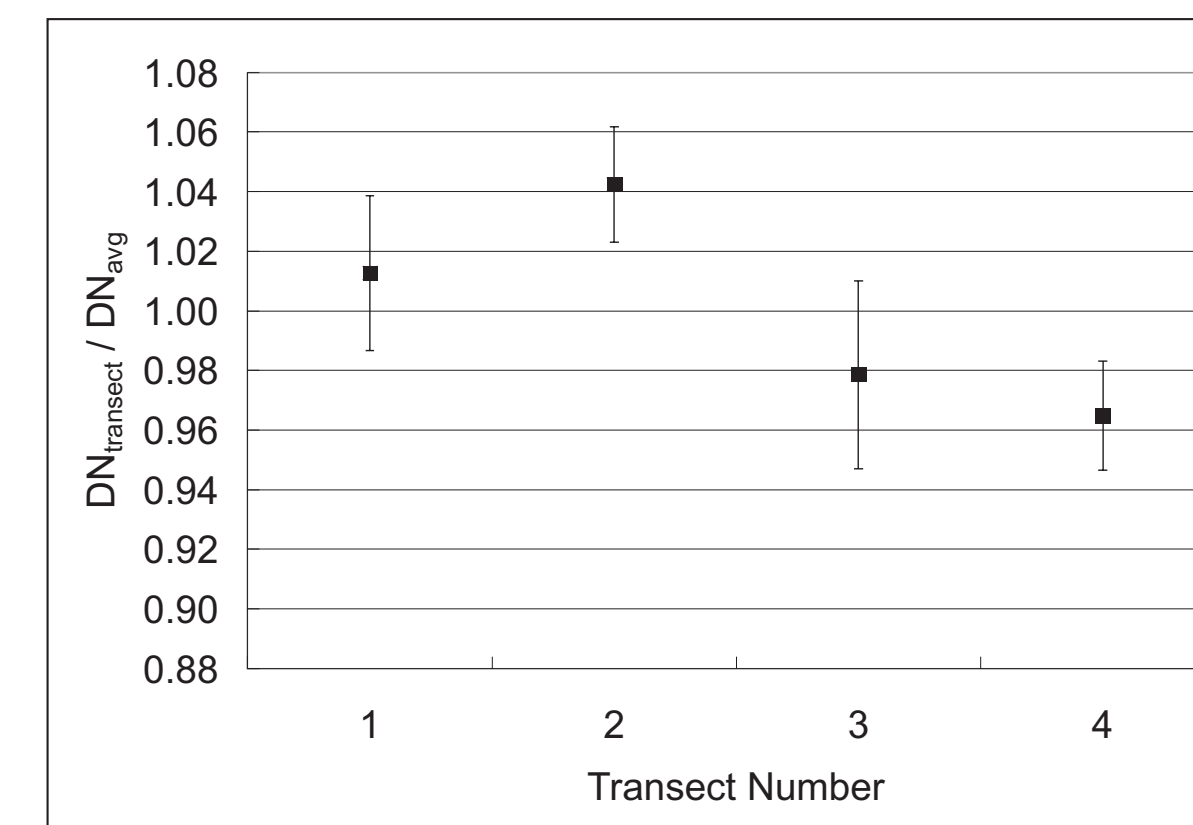
Histogram of DNs in QuickBird panchromatic image of 1-km² RadCaTS site.

CURRENT WORK

- The reflectance-based approach continues to be used successfully at Railroad Valley Playa, Nevada (N38.497°, W115.690°).
- Automated RadCaTS data are being used to supplement the data collected using on-site personnel.
- This study uses high-spatial-resolution (60 cm) QuickBird panchromatic-band data to quantify the uncertainty in surface BRF retrieval due to the position of the automated ground-viewing radiometers on the 1-km² site at Railroad Valley.
- The position and number of ground-viewing radiometers on the large-footprint site at Railroad Valley is being evaluated.
- Random sampling of the 1-km² site is used to determine how well the four radiometers represent the entire site
- The pattern that one carries the portable spectroradiometer across the large-footprint site is evaluated to determine if it adequately samples the entire 1-km² site.

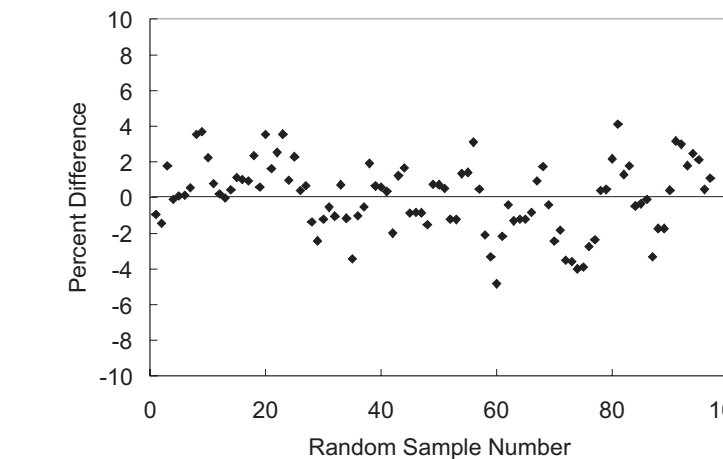
Portable Spectroradiometer Results

- Path walked by spectroradiometer operator was analyzed using QuickBird image
- Approximately 4.7 km total distance
- **Result:** average value is 1053.9 DN (versus 1059.5 DN for total site)
- 0.5% difference
- Spectroradiometer path is indicative of entire site



Random Sampling of Site

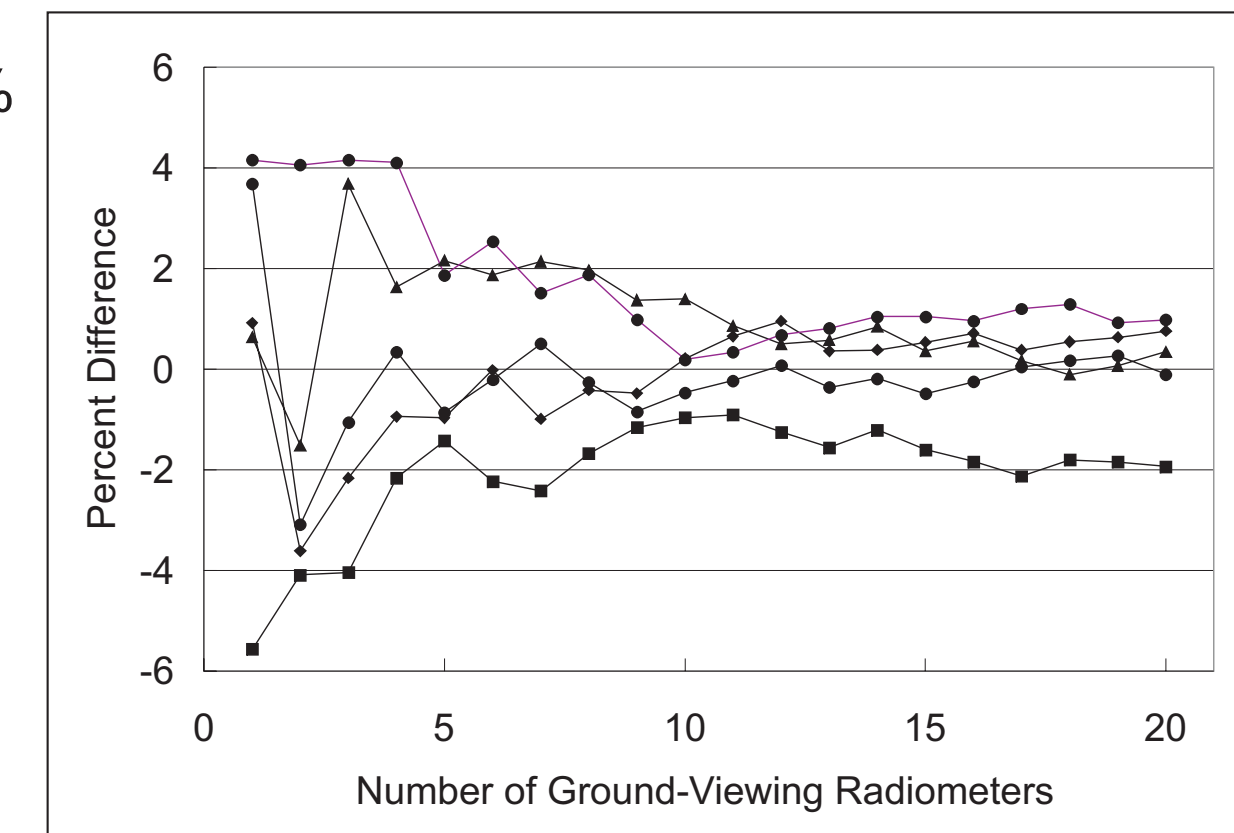
- Analysis of present four radiometers
 - Average value of 1013.8 DN (versus 1059.5 DN for total site)
 - Approx. 3.4% lower
- Next step: determine average value of four radiometers for 100 samples
- **Result:** average percent difference is 0.04% from average of entire site
 - Standard deviation (1 σ) is 1.9%
 - One could expect to be within $\pm 2\%$ of average BRF by randomly placing 4 radiometers throughout the site



| Column | Row | DN |
|--------|------|------|
| 6248 | 6118 | 1040 |
| 7336 | 5643 | 1135 |
| 6310 | 5920 | 1042 |
| 6151 | 5102 | 1021 |
| 6487 | 5737 | 1061 |
| 7384 | 4909 | 1000 |
| 6390 | 6164 | 1121 |
| 6527 | 5198 | 1012 |
| 7267 | 5323 | 1060 |
| 7188 | 4785 | 982 |
| 6385 | 5013 | 996 |
| 6960 | 5126 | 1005 |

Running average of four points

for 100 samples



CONCLUSIONS and FUTURE WORK

- Panchromatic QuickBird data show that the large-GIFOV site at Railroad Valley is spatially uniform to approximately 4.5% of the average value.
 - **Future work:** Analyze the large-footprint site at Railroad Valley using multispectral data to determine surface BRF uniformity as a function of wavelength. This will assist in the design of new radiometers for the site.
- The present path used to spatially sample the large-footprint site with portable spectroradiometers does provide an average value that represents the entire site.
 - **Future work:** Determine if a smaller surface area can be sampled while still maintaining the same level of accuracy. The benefit is reduction of time and therefore less change in solar zenith angle throughout the collect.
- Randomly placing four ground-viewing radiometers allows the surface BRF to be measured to within $\pm 2\%$ of the average value of the site.
- The number of automated ground-viewing radiometers presently at Railroad Valley is sufficient to obtain an average BRF value that represents the entire site
- The four radiometers currently on the large-footprint site have a slightly higher percent difference than the random sample
 - **Future work:** Assess the present location of the ground-viewing radiometers and determine possible new locations